Ordering number: EN2088E

Monolithic Linear IC

SANYO No.2088E

LA4558

2-Channel AF Power Amp

Features

- Low quiescent current
- On-chip 2 channels permitting use in stereo and bridge amplifier applications
- High output
- Minimum number of external parts required (9 pcs. minimum)
- Good ripple rejection (60dB)
- Soft tone at the output saturation mode
- Good channel separation
- Easy thermal design
- Small pop noise at the time of power supply ON/OFF

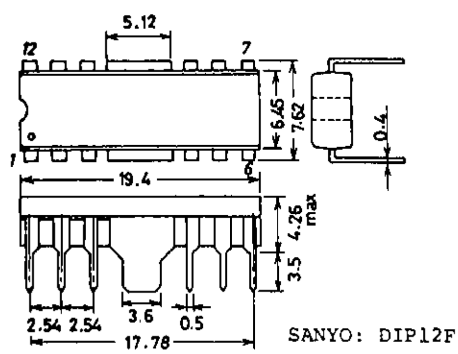
Maximum Ratings at Ta = 25°C

				unit
Maximum Supply Voltage	V_{CC} max	Quiescent	15	V
		Operating	12	V
Allowable Power Dissipation	Pd max	With recommended PCB	4	W
Operating Temperature	Topr		−20 to +75	°C
Storage Temperature	Tstg		−55 to +150	°C

Operating Conditions at Ta = 25°C

				unit
Recommended Supply Voltage	V_{CC}		7.5 to 9.0	V
Recommended Load Resistance	R_L	Stereo	3 to 8	Ω
		BTL	8	Ω
Operating Voltage Range	V_{CC} op		4.5 to 12	V

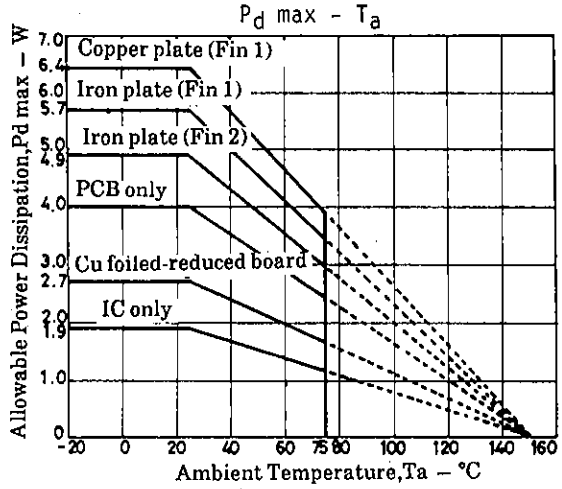
Package Dimensions
(unit: mm)
3022A

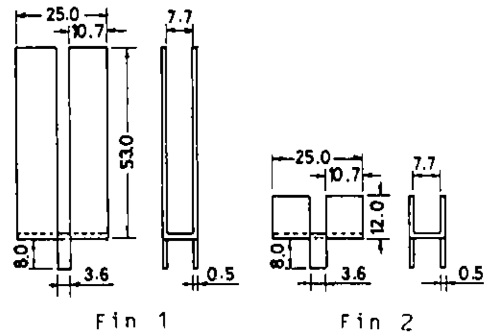


Operating Characteristics at Ta = 25°C, V_{CC} = 9V, f = 1kHz, Rg = 600Ω, R_L = 4Ω, VG = 50dB, See specified Test Circuit.

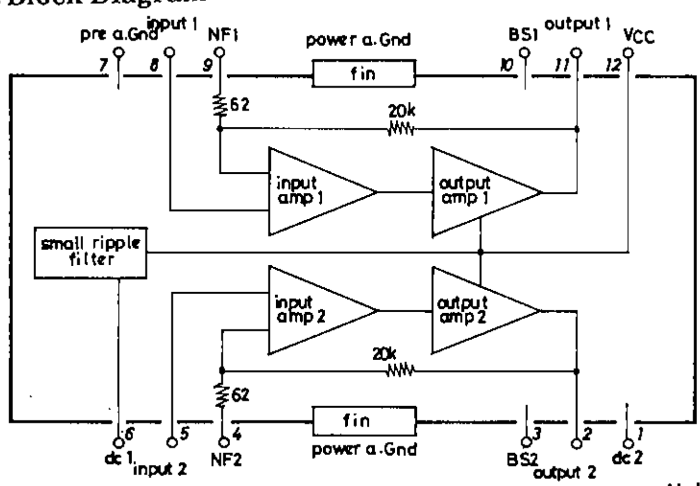
			min	typ	max	unit
Quiescent Current	Icco	Rg = 0		20	40	mA
Voltage Gain	VG	V_{IN} = −50dBm	48	50	52	dB
Voltage Gain Difference	ΔVG	V_{IN} = −50dBm			±1	dB
Output Power	Po	THD = 10%, stereo	1.7	2.4		W
		THD = 10%, BTL (R_L = 8Ω)		4.5		W
Total Harmonic Distortion	THD	Po = 250mW		0.3	1.0	%
Input Resistance	ri		21	30		kΩ
Output Noise Voltage	V_{NO}	Rg = 0, stereo		0.5	1.0	mV
		Rg = 10kΩ, stereo		0.8	2.0	mV
Ripple Rejection	Rr	Rg = 0, f_R = 100Hz, V_{CCR} = 0dBm	55	60		dB
Crosstalk	CT	Rg = 10kΩ, V_O = 0dBm	45	55		dB

P_d max − T_a



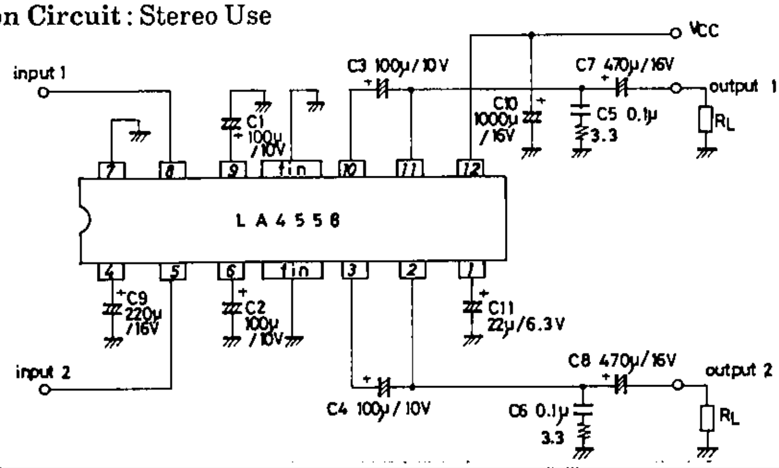


Equivalent Circuit Block Diagram

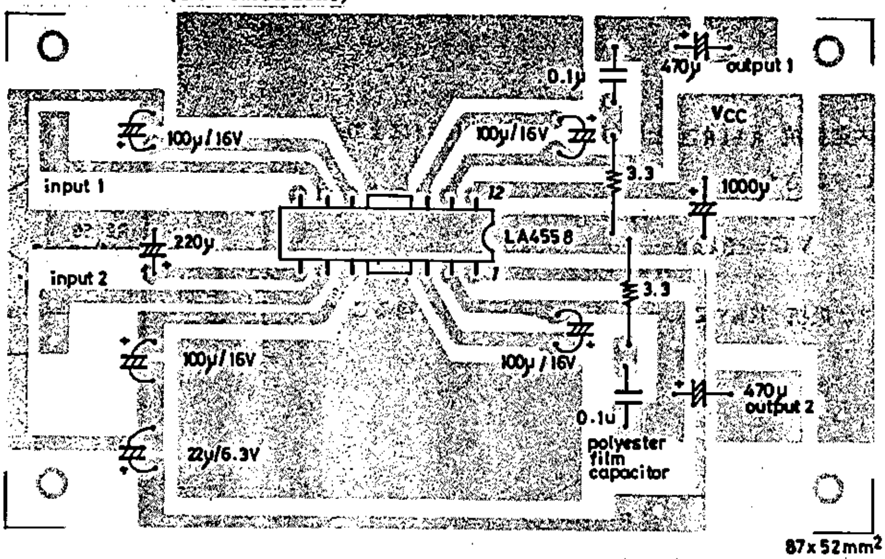


Unit (resistance: Ω, capacitance: F)

Sample Application Circuit : Stereo Use

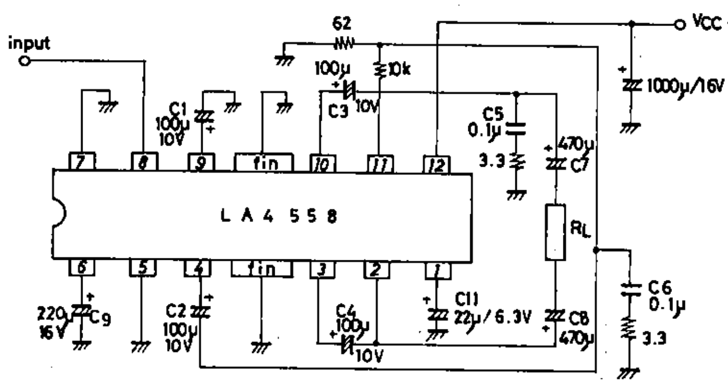


Sample Printed Circuit Pattern (Cu-foiled side)



Sample Application Circuit: Bridge Amp Use

Unit (resistance: Ω, capacitance: F)



Description of External Parts

C1 (C2): Feedback capacitor. The low cutoff frequency is determined by the following formula.

$$f_L = \frac{1}{2\pi C1 R_f}$$

f_L: Low cutoff frequency

R_f: Feedback resistor

Since this capacitor as well as decoupling capacitor affects the starting time, the capacitor value must be fixed with the necessary low frequency band fully considered.

C3 (C4): Bootstrap capacitor. The output at low frequencies depends on this capacitor. Decreasing the capacitor value lowers the output at low frequencies. A capacitor value of 47μF or more is required.

C5 (C6): Oscillation blocking capacitor. Use a polyester film capacitor that is good in high frequency response and temperature characteristic. the use of an electrolytic capacitor, ceramic capacitor may cause oscillation to occur at low temperatures.

C7 (C8): Output capacitor. The low cutoff frequency is determined by the following formula.

$$f_L = \frac{1}{2\pi C7 R_L}$$

f_L: Low cutoff frequency

R_L: Load resistance

To make the low frequency response in the bridge amplifier mode identical with that in the stereo mode, the capacitor value must be doubled.

C9: Decoupling capacitor CD1. Used for the ripple filter. Since the rejection effect is saturated at a certain capacitor value, it is meaningless to increase the capacitor value more than needed. This capacitor, being also used for the time constant of the muting circuit, affects the starting time.

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C10 : Power source capacitor

C11 : Decoupling capacitor CD2. Used for the ripple filter. Particularly effective for transient characteristic.

Application Circuits

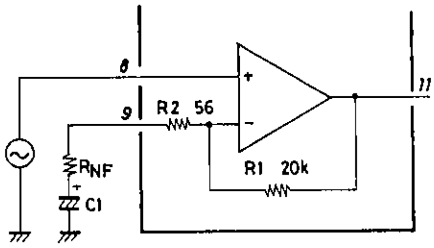
Voltage gain adjust

· Stereo mode

The voltage gain is determined by on-chip resistor R1 (R2) and external feedback resistor R_{Nf} as follows :

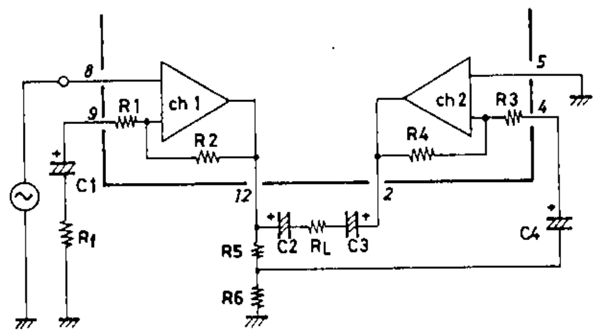
$$VG=20\log\frac{R1}{R_{Nf}+R2}\ [dB]$$

Any voltage gain can be obtained by external resistor R_{Nf}.



Unit (resistance: Ω)

· Bridge amplifier mode



The CH1 is a noninverting amplifier and the CH2 is an inverting amplifier. The total voltage gain, being apparently higher than that of the CH1 by 6dB, is approximately calculated by the following formula.

$$VG=20\log R2/R1+6\ (dB)$$

To reduce the voltage gain, Rf is connected and the following formula is used.

$$VG=20\log R2/Rf+R1+6\ (dB)$$

Proper cares in using LA4558-applied set

1. Slider contact noise of variable resistor
   Since the input circuit uses PNP transistors, no input coupling capacitor is required. However, if slider contact noise of the variable resistor presents any problem, connect a capacitor in series with input.

2. Pop noise
   If pop noise generated at the time of power ON/OFF disturbs you, connect a resistor of 500Ω to 1kΩ across the middle point and GND.

Thermal Design

Since the DIP-12F package is such that the Cu-foiled area of the printed circuit board is used to dissipate heat, make the Cu-foiled area in the vicinity of the heat sink of the IC as large as possible when designing the printed circuit board. Power dissipation Pd is increased depending on the supply voltage and load. So, it is recommended to use the printed circuit board together with the heat sink. The following is a formula to be used to calculated Pd (for stereo use). For AC power supply, however, it is recommended to actually measure Pd on the transformer of each set. For bridge amplifier use, Pd is calculated at 1/2 of the load.

1) DC power supply

$$Pd\ max=\frac{Vcc^2}{\pi^2 R_L}+Icco\cdot VCC(2チャネル分)\cdots\cdots(1)$$ (For stereo use)

2) AC power supply

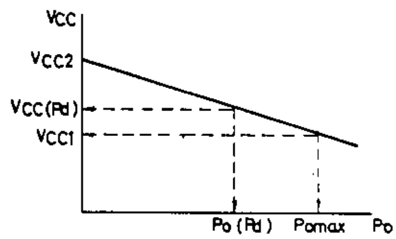
V_{CC2} : Supply voltage at quiescent mode

$V_{CC}(Pd)$: Supply voltage at Pd max

V_{CC1} : Supply voltage at maximum output

r : Voltage regulation $\dfrac{V_{CC2}-V_{CC1}}{V_{CC1}}$

Icco : Quiescent current



Line regulation

$$Pd\ max = \frac{V_{CC}(Pd)^2}{\pi^2 R_L} + I_{cco} \cdot V_{CC}(Pd) \text{ (For stereo use)} \quad \cdots (2)$$

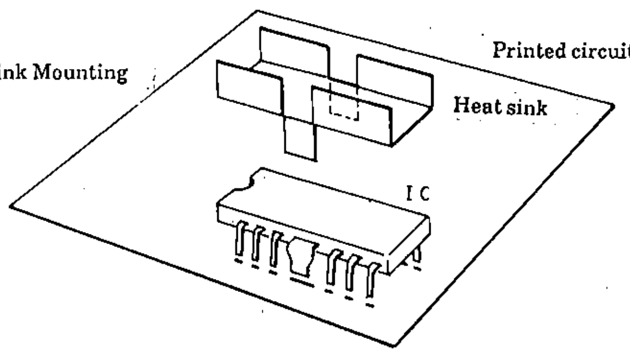
where

$$V_{CC}(Pd) = \frac{(1+r)V_{CC1}}{1+\dfrac{r \cdot V_{CC1}}{\sqrt{2} \cdot \pi \cdot R_L} \times \sqrt{\dfrac{R_L}{Po\ max}}}$$

Example of Heat Sink Mounting Method

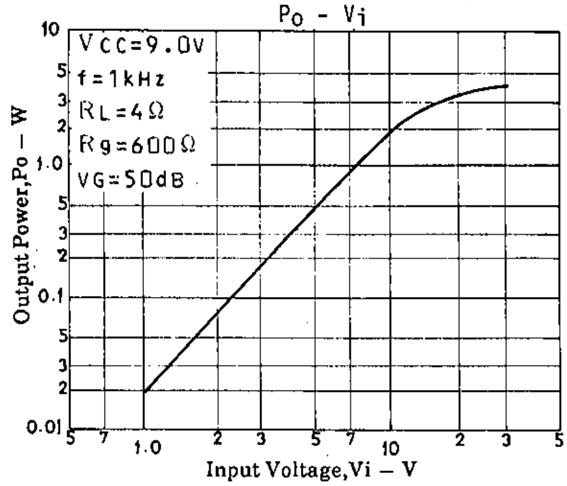
The heat sink must be of such a shape as to be able to dissipate heat from the IC plastic area and fin area and is soldered to the printed circuit board as shown below. For the size of the heat sink, refer to the Pd-Ta characteristic. The material of the heat sink is recommended to be copper or iron which is solderable. It is recommended to apply silicone grease to the IC plastic area to reduce thermal resistance between the heat sink and the IC plastic area.

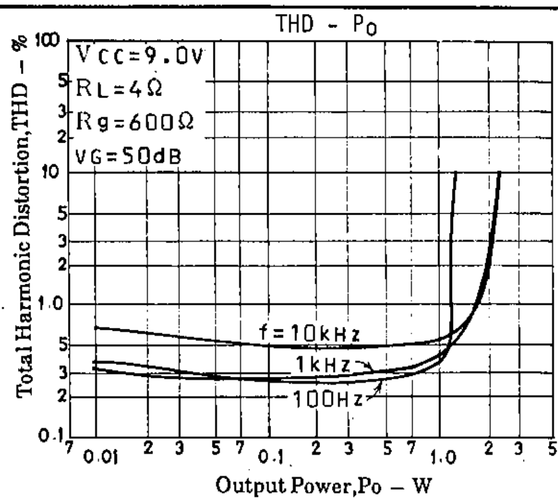
Example of Heat Sink Mounting

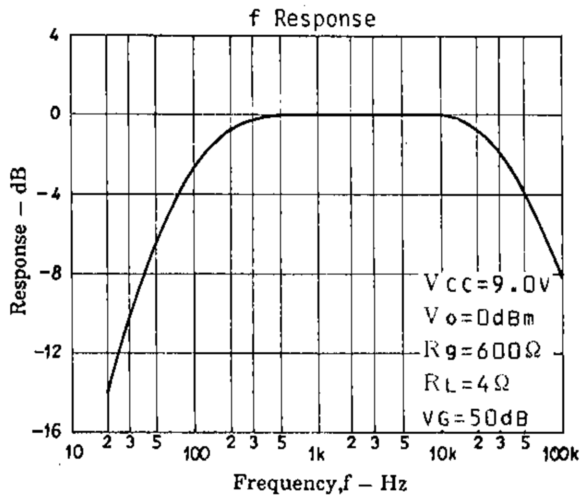


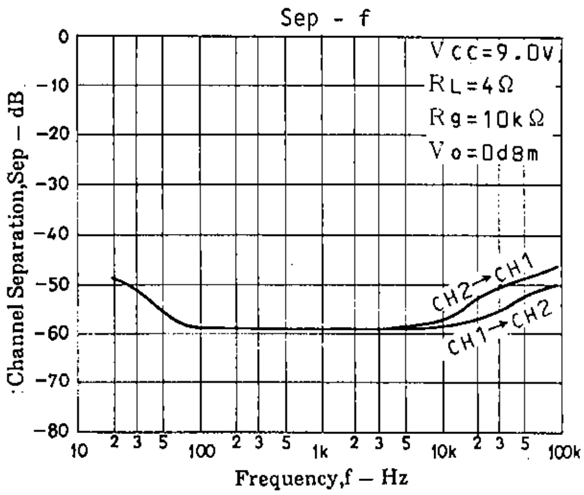
Proper Cares Using IC

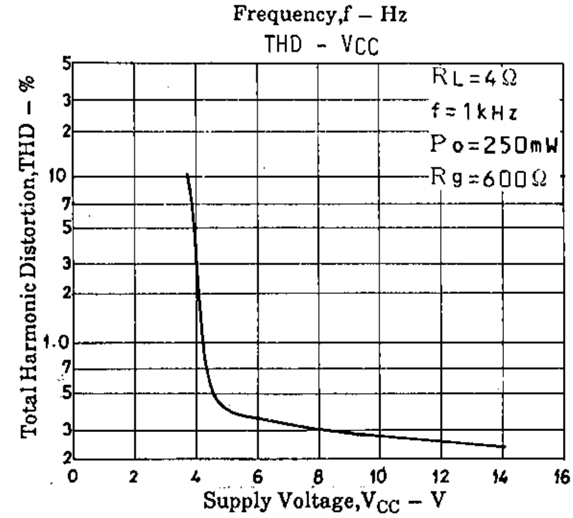
1. If the IC is used in the vicinity of the maximum ratings, even a slight variation in conditions may cause the maximum ratings to be exceeded, thereby leading to breakdown. Allow an ample margin of variation for supply voltage, etc. and use the IC in the range where the maximum ratings are not exceeded.
2. Pin-to-pin short : If power is applied when the space between pins is shorted, breakdown or deterioration may occur. When mounting the IC on the board or applying power, make sure that the space between pins is not shorted with solder, etc.
3. Load short : If the IC is used with the load shorted for a long time, breakdown or deterioration may occur. Be sure not to short the load.
4. When the IC is used in radios or radio cassette tape recorders, keep a good distance between IC and bar antenna.
5. When making the board, refer to the sample printed circuit pattern.
6. It should be noted that some plug jacks to be used for connecting to the external speaker are such that both poles are shorted once when connecting.

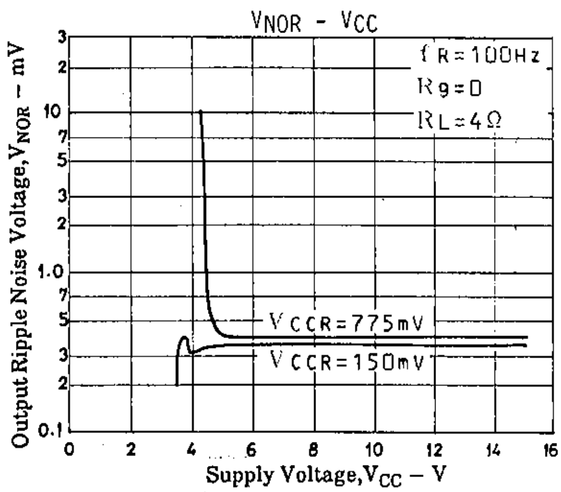

Po - Vi
VCC=9.0V
f=1kHz
RL=4Ω
Rg=600Ω
VG=50dB
Output Power,Po – W
Input Voltage,Vi – V

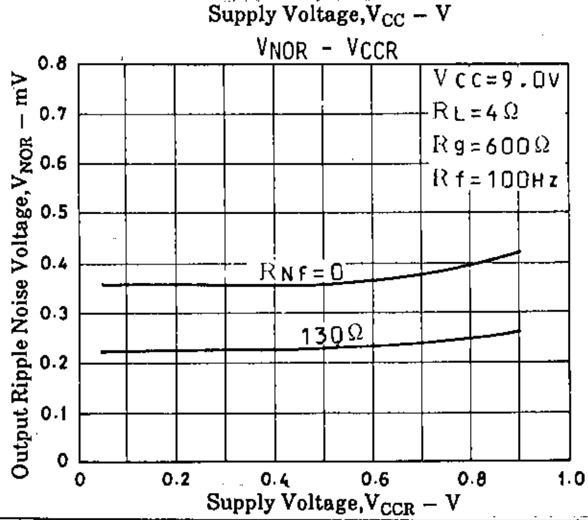

THD - Po
VCC=9.0V
RL=4Ω
Rg=600Ω
VG=50dB
f=10kHz
1kHz
100Hz
Total Harmonic Distortion,THD – %
Output Power,Po – W

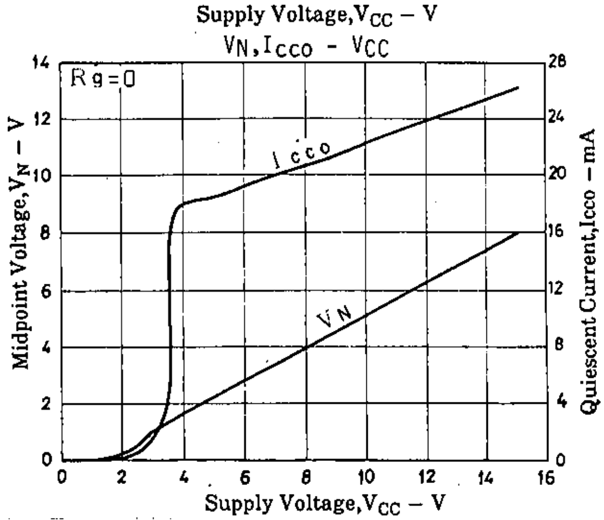

f Response
VCC=9.0V
Vo=0dBm
Rg=600Ω
RL=4Ω
VG=50dB
Response – dB
Frequency,f – Hz


Sep - f
VCC=9.0V
RL=4Ω
Rg=10kΩ
Vo=0dBm
CH2→CH1
CH1→CH2
Channel Separation,Sep – dB
Frequency,f – Hz

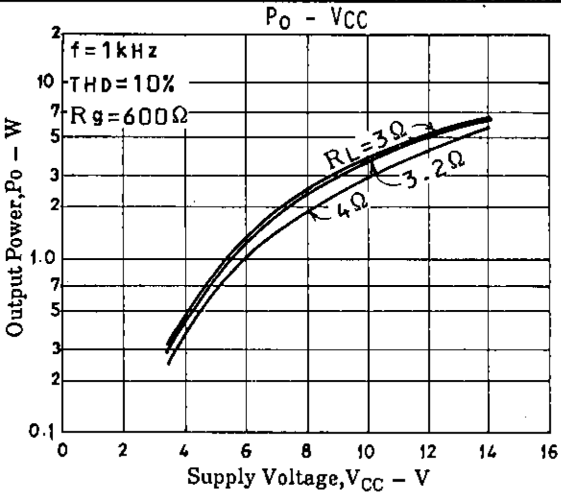

THD - VCC
RL=4Ω
f=1kHz
Po=250mW
Rg=600Ω
Total Harmonic Distortion,THD – %
Supply Voltage,VCC – V


VNOR - VCC
fR=100Hz
Rg=0
RL=4Ω
VCCR=775mV
VCCR=150mV
Output Ripple Noise Voltage,VNOR – mV
Supply Voltage,VCC – V

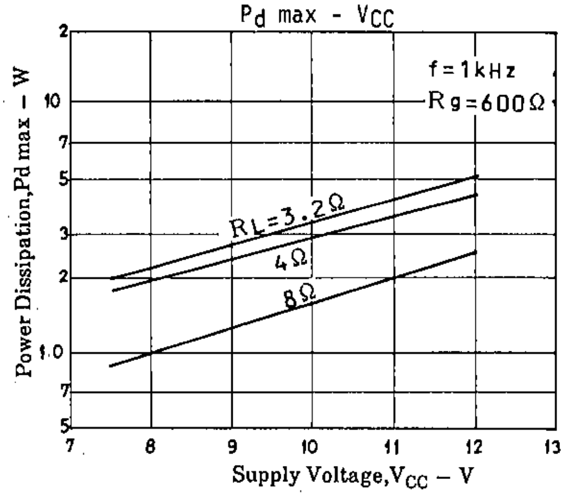

VNOR - VCCR
VCC=9.0V
RL=4Ω
Rg=600Ω
Rf=100Hz
RNf=0
130Ω
Output Ripple Noise Voltage,VNOR – mV
Supply Voltage,VCCR – V


VN,Icco - VCC
Rg=0
Icco
VN
Midpoint Voltage,VN – V
Quiescent Current,Icco – mA
Supply Voltage,VCC – V

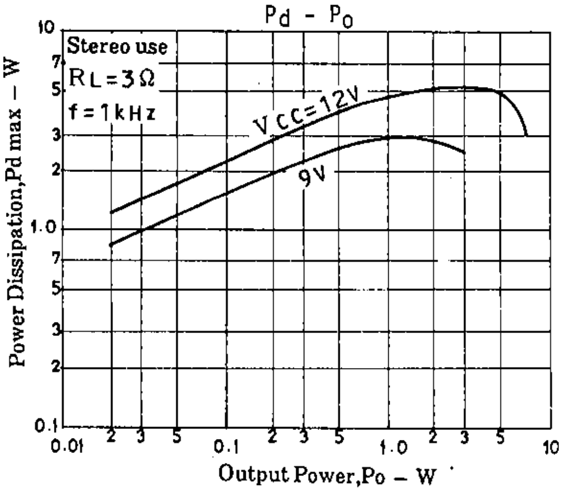
Po - VCC



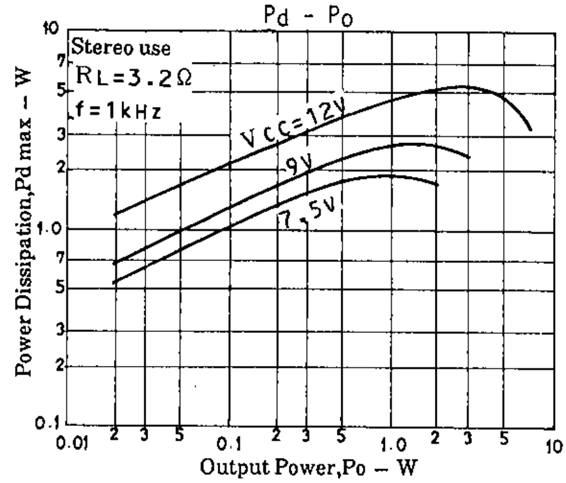
Pd max - VCC



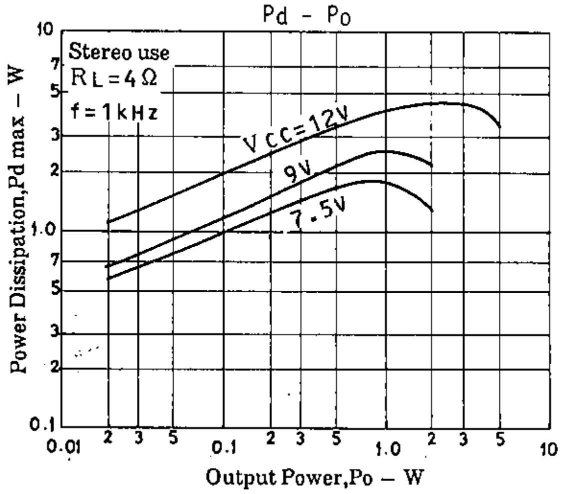
Pd - Po



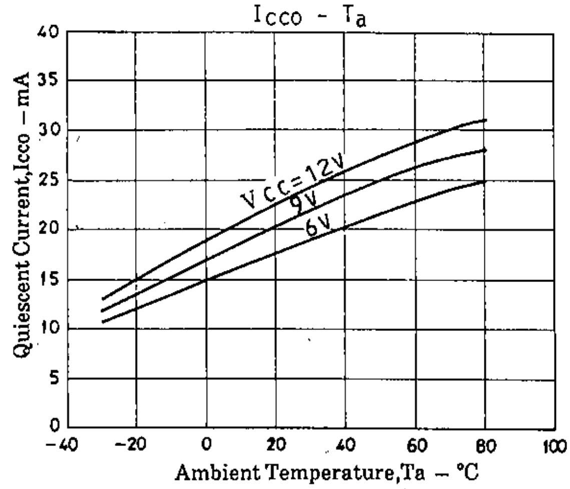
Pd - Po



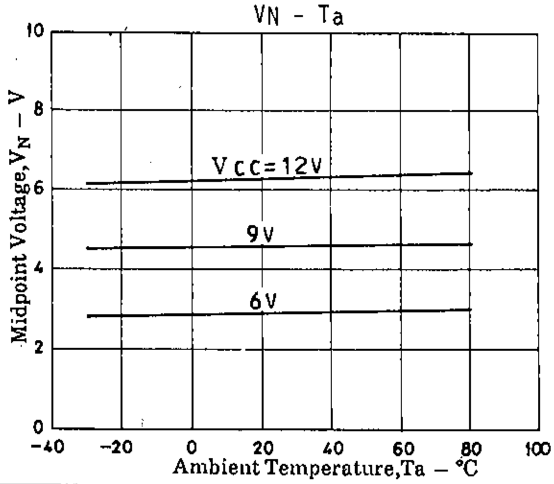
Pd - Po



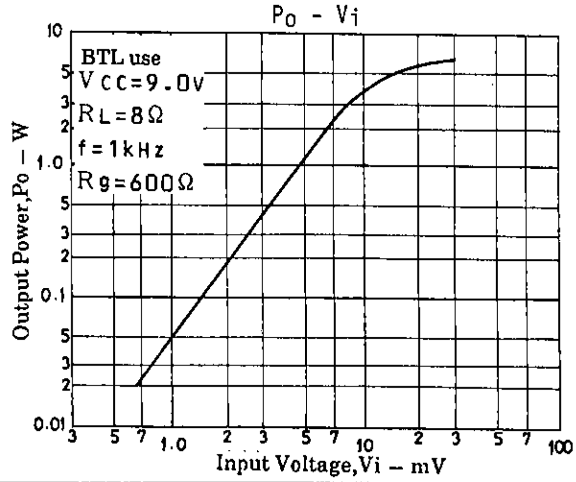
Icco - Ta



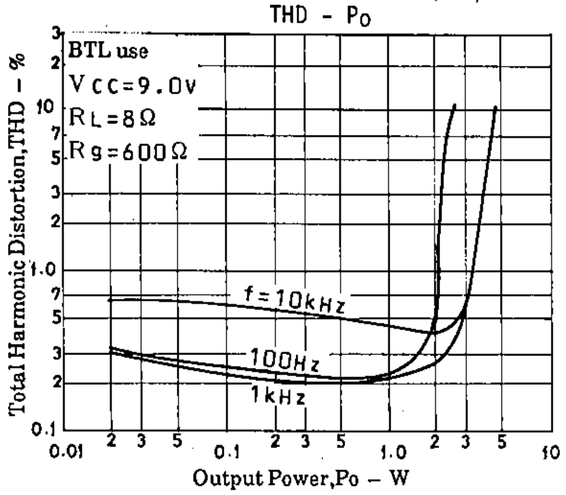
VN - Ta



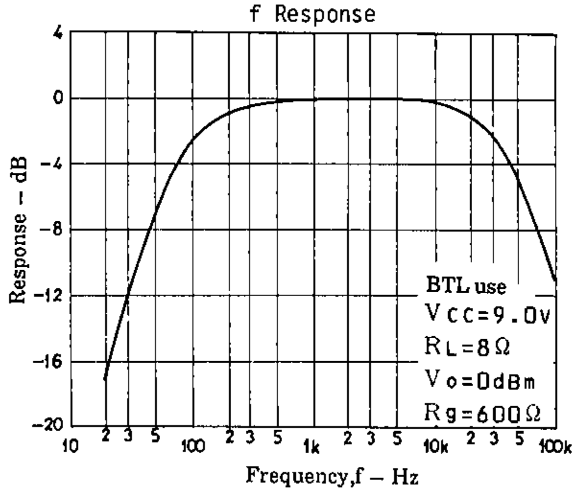
Po - Vi



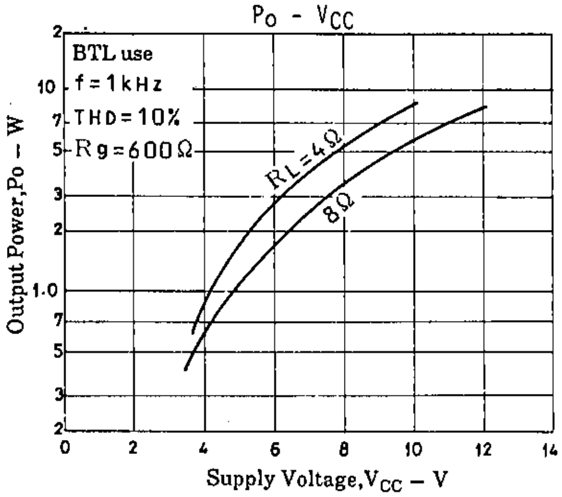
THD - Po



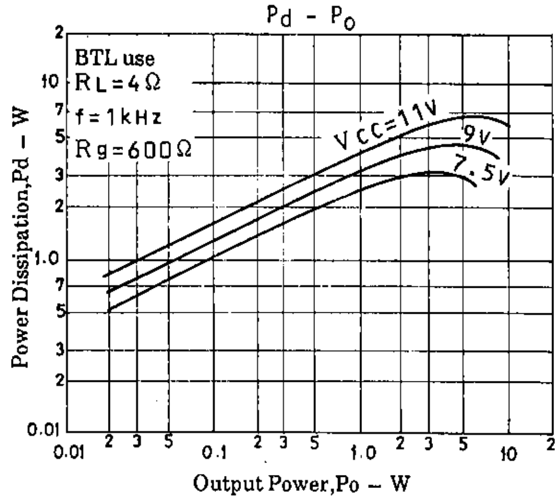
f Response



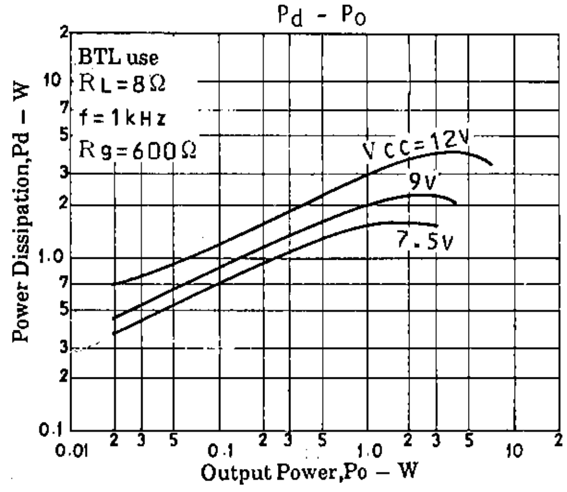
Po - VCC



Pd - Po



Pd - Po



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